IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 3, July 2026
Impact Factor: 8.2

AI Powered Car Damage Detection Using Deep Learning

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Abstract: *Damage appraisal of vehicles is a critical component of motor insurance, car repair estimation, used car appraisal, and accident documentation. Manual appraisal methods generally carried humans. The car repair technician inspects the damaged vehicle, detects the damaged parts, and estimates the visual damage extent. Although manual intervention may be necessary in the subsequent stages of legal, structural, or monetary analysis of the damages, the procedure could be both tedious and time-consuming. The proposed project focuses on automating the first stage of this procedure using a computer vision system.The project employs an object detection model using the YOLOv8 framework for detecting and classifying six different kinds of damages of cars*

Keywords: *Damage appraisal*

I. INTRODUCTION

Vehicle inspection is a widespread process, which is rather simple. Insurers check the damages on cars in order to calculate the claim; repair shops analyze the damage in order to provide an estimate; fleet owners document any damages in order to maintain it later; and used car dealers examine the car's exterior before making a deal. The accuracy of the primary assessment affects all further processes. Any delay or problem in the first process increases the workload for the other processes and consequently slows down the whole procedure. At the moment, vehicle inspection is carried out manually. An experienced expert can interpret the obtained results by comparing them to the areas that are hard to see. Such an inspection is needed when the case is complicated, there issues security or it is worthwhile to pay off the expenses for repair. But the process is vulnerable to human mistakes due to its manual nature. The same activity done repeatedly requires great persistence and concentration. The technician would need to identify damaged parts, label them, describe what kind of parts those are, figure out the patterns. In the case of similar tasks, this is already boring and routine-like work of the same actions performed over and over again, with the analysis of each picture. These are the cases where computer vision technology would be beneficial, as it could study the patterns and similarities in the pictures.

Traditional computer vision applications use filters that were programmed to detect edges, patterns and colors in the image. deep neural network it is possible to tell images apart based on patterns that the network learned from the data. This makes it possible to build models that're flexible and can be used in many different situations but only if there is enough training data. Annotated examples help the software learn what features to look for to solve a task even if they are not obvious to a human. For example if a car has no shadows or highlights on its surface it might be a dent.. A beginner might think it is a construction defect.

II. METHODOLOGY

The technical structure outlines the sequence of events and processes to be performed to convert an innovative idea into a functional prototype. The applied principle is iterative, as the quality of the collected data, performance of the model and integration of the application affects each other. The issues with the training dataset may indicate the need for the data annotation amendments, while the problems with the results of the model might suggest adjustments in the data

DOI: 10.48175/IJARSCT-37886

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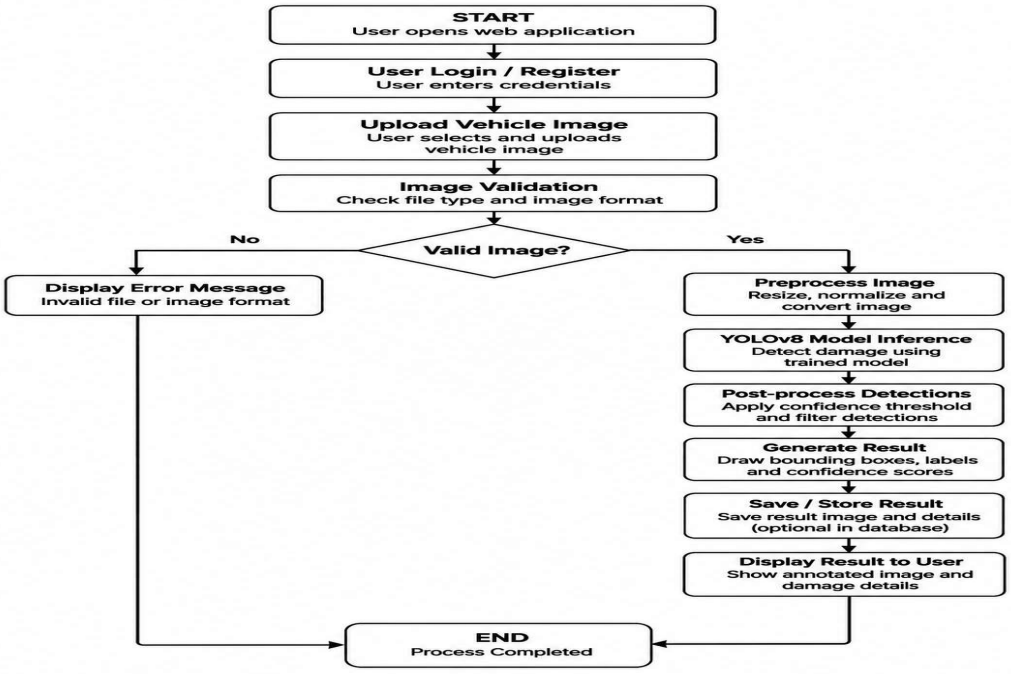
confidence treatment and image preparation. Thus, separate major components undergo development and verification before the application logic is tested as a whole.

The basic methodology consists of business requirement analysis, data gathering, data preparation, planning, architecture design, environment preparation, front-end development, back-end development, modeling and putting it into operation. The database development is mentioned here because the format of the report requires doing it. Nonetheless, the currently available project materials do not include database files, schemas or codes indicating the limitations of the applicability of this technology.

III. MODELING AND ANALYSIS

Sl.no	Materials/Tools	Purpose/Usage
1	Python	Core programming language for developing the application
2	YOLOv8	Detecting and classifying car damage in images
3	OpenCV	Image processing, preprocessing and visualization
4	Flask	Developing the web interface application
5	HTML, CSS, JavaScript	Designing the user interface

IV. FLOW DIAGRAM



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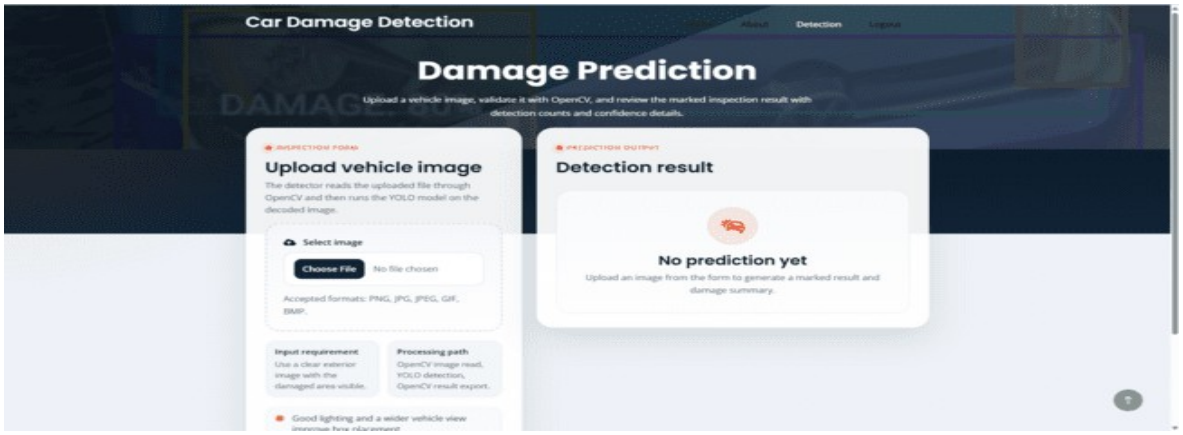
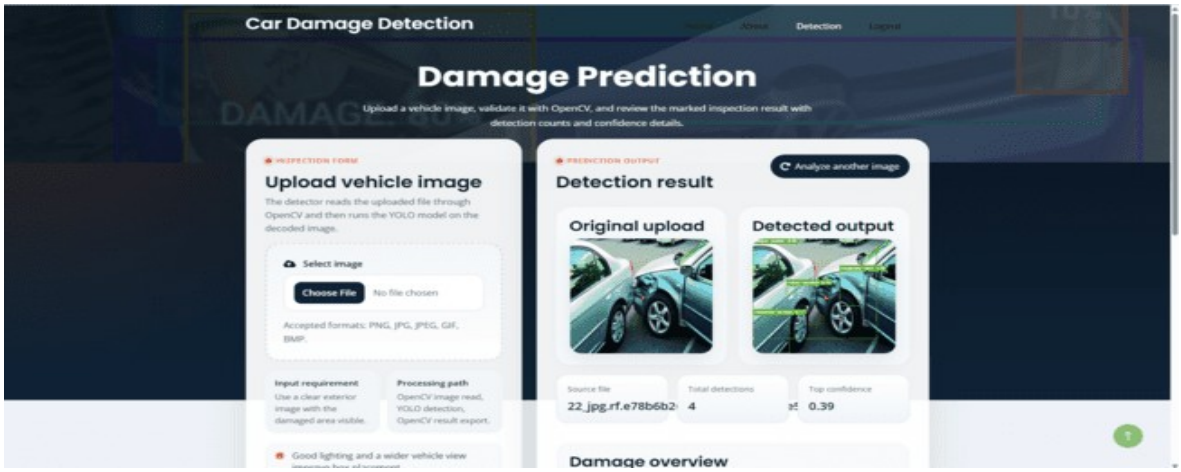
SNAPSHOTS





V. CONCLUSION

Project proposes a solution for the problem of early detection of damages of cars using the YOLOv8 object-detection algorithm. The program is intended to receive an image from the user, detect the areas of damage, and return the results with annotations through a web interface using Flask. The chosen classes classify denting, scratching, and breaking of a car into categories of minor, medium, and major damage.The innovation aspect of the research is related to the introduction of custom object detection into the simple application framework. Bounding boxes contain spatial

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information which cannot be retrieved by the entire image classifier. The pretrained YOLOv8 can decrease learning of general visual features, and Flask offers the easiest way from browser input to model output.The review of literature reveals that vehicle damage recognition still poses difficulties due to data privacy and imbalance, as well as reflective surfaces, minor defects, and inconsistent labeling of severity of the damage. The project opts for the lightweight one-stage detector instead of more complicated segmentation or multiple models used by insurance companies. This approach

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